

Elemental composition and toxicity of waters of the transboundary rivers of Kazakhstan

Solodukhin V.P., Lennik S.G., Severinenko M.A.,
Kabirova G.M., Zheltov D.A., Bychenko A.N.

Institute of Nuclear Physics ME RK, 050032, Kazakhstan, Almaty, Ibragimov st. 1

Since spring 2007, the INP ME RK jointly with the RSE "Kazhydromet" has been performing the activities on survey and monitoring of the radiation and environmental situation in 15 border sections of the rivers flowing into the territory of Kazakhstan (see Figure 1). The methodology, developed by the team of the scientists from Central Asia (Kyrgyzstan, Uzbekistan, Tajikistan, Kazakhstan) and the United States, is used in the process of survey of the transboundary rivers Syrdariya and Amudariya under the International Project "Navruz". Sampling of the environmental objects at the specified control points (CP) is carried out annually, in spring and autumn. The radionuclide and elemental composition of soil, bottom sediments and water samples is determined in the laboratory conditions using the IGS, RChA, NAA, XRF, MS-ICP and OES-ICP methods

The report provides the results of the study of elemental composition of the water samples collected at these 15 CPs in the period of 2016-2020. The values of more than 30 elements were determined by the NAA, MS-ICP and OES-ICP methods. According to the obtained data, it was established that the highest concentrations of such toxic elements as As, Ba, Li, Mo, Sb, Sr, U correspond to the waters of the rivers of South and South-East Kazakhstan (Emel, Shu, Syrdariya and especially Karabalta). The highest content of Cr, P and the high content of Sb and As were revealed in the waters of the Ural, Chagan and Ilek rivers. It was also established that the waters of the Tobol and Ayat rivers are characterized by the highest content of Ni, Co, Zn and Fe. The content of Ca, K, and Mg in most of the studied water samples significantly exceeds the corresponding clarke values.

The values of total toxicity (the limiting hazard indicator - K_{HL}) of all studied waters were calculated in accordance with the methodology, established by the "Sanitary Rules of the Republic of Kazakhstan". The calculations were performed based on the concentration of U (element of hazard class 1) and As, B, Ba, Li, Mo, Pb, Sb, Sr (elements of hazard class 2) in these waters. The values of MAC_{WHO} (for Li and Sr – MAC_{RK}) were used for most of them. The result, based on the average values of these elements in spring and autumn are provided in Figure 1. From the scheme it follows that the K_{HL} indicator at most of the control points exceeds the sanitary standard of 1.0. The waters of these rivers are in critical condition in terms of chemical toxicity and exposed to many risks of additional contamination in the neighboring countries (Russia, China, Kyrgyzstan, Uzbekistan and Tajikistan).

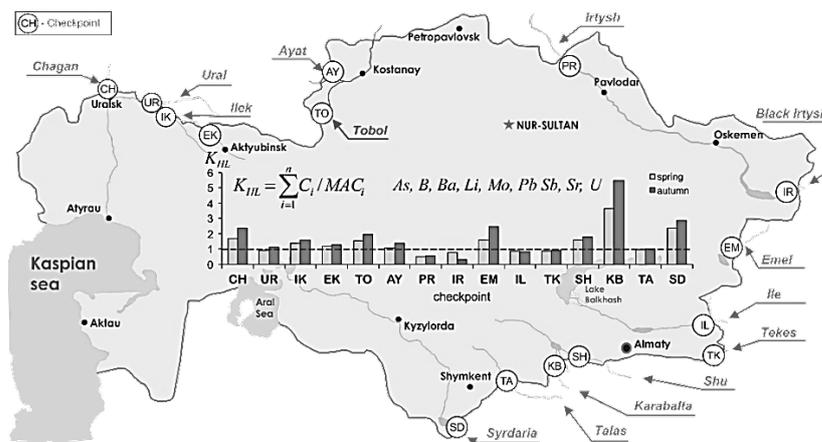


Figure 1. Scheme of the transboundary rivers monitoring in Kazakhstan. Chemical toxicity of waters of these rivers (center)